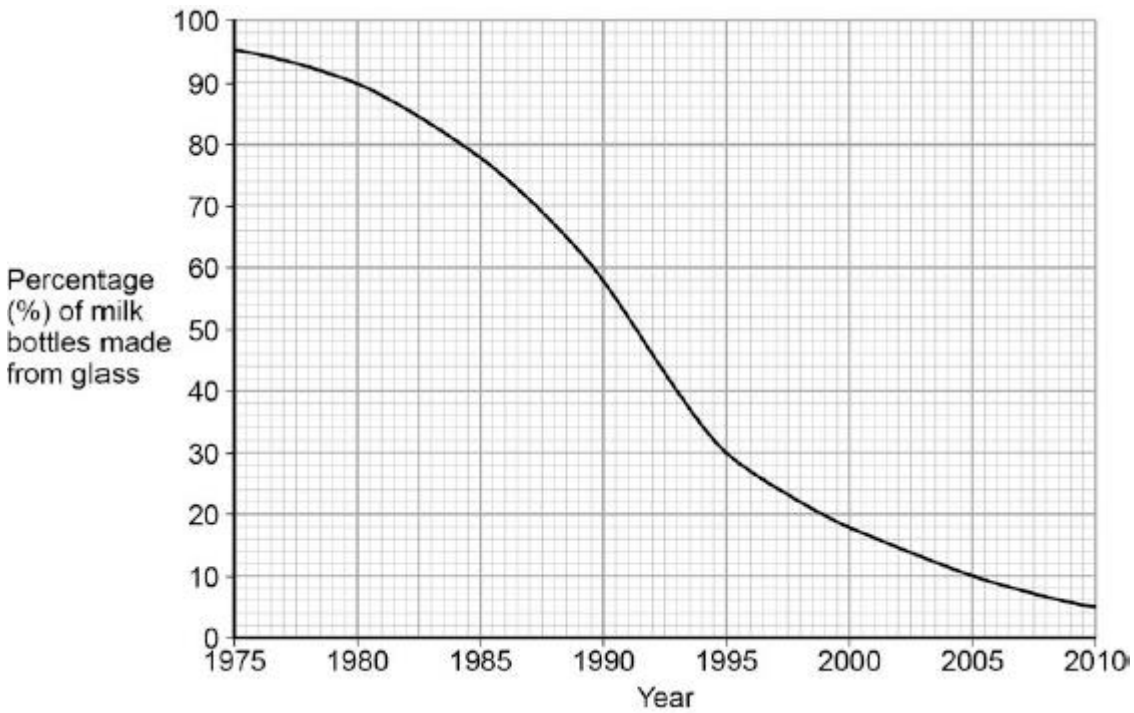
Q1. Plastic and glass can be used to make milk bottles.

The figure below shows the percentage of milk bottles made from glass between 1975 and 2010.



(a) Plot the points and draw a line on the figure above to show the percentage of milk bottles made from materials **other** than glass between 1975 and 2010.

(3)

(b) The table below gives information about milk bottles.

	Glass milk bottle	**Plastic milk bottle**
Raw materials	Sand, limestone, salt	Crude oil
Bottle material	Soda-lime glass	HD poly(ethene)
Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.
Maximum temperature in production process	1600 °C	850 °C
Number of times bottle can be used for	25	1

milk		
Size(s) of bottle	0.5 dm^3	0.5 dm^3, 1 dm^3, 2 dm^3, 3 dm^3
Percentage (%) of recycled material used in new bottles	50 %	10 %

Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

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(6)
(Total 9 marks)

Q2. Cans for food and drinks are made from steel or aluminium.The main metal in steel is iron.

By Sun Ladder (Own work) [CC-BY-SA-3.0 or GFDL],
via Wikimedia Commons

(a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

(i) Name this type of reaction.

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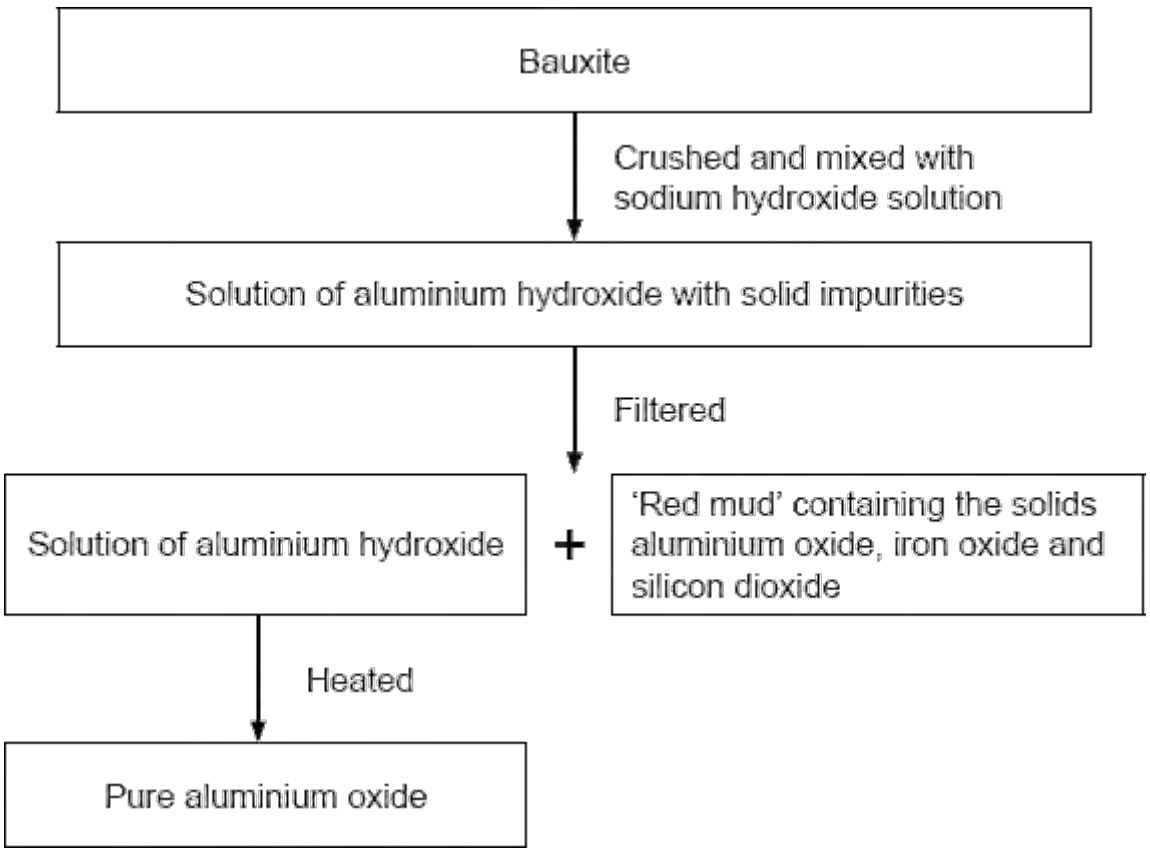
(1)

(ii) Balance the symbol equation for this reaction.

$2Fe_2O_3$ + ... C → ..... Fe + ... CO_2

(1)

(b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide. Aluminium is extracted by electrolysis of aluminium oxide.



The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

(i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

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Answer = ... %

(1)

(ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

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(1)

(iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

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(1)

(c) Aluminium is used to make many things including cans.

During one year in the USA:

- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental .....

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Ethical or social .....

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(2)
(Total 7 marks)

Q3. The flow diagram shows the main stages used to extract a metal from its ore.

mining the ore → purifying the ore → extracting the metal

The table shows some information about three metals.

Metal	Metal ore	Purified ore	% of metal in the ore	% of metal in the Earth's crust
aluminium	bauxite	aluminium oxide, Al_2O_3	28.0	8.0
copper	chalcocite	copper sulfide, Cu_2S	0.5	0.001
iron	haematite	iron oxide, Fe_2O_3	29.0	5.0

(a) Use the information in the table and your knowledge and understanding to help you to answer the questions.

(i) Suggest why purifying the copper ore produces large quantities of waste.

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(1)

(ii) Suggest why the annual world production of iron is forty times greater than that of aluminium.

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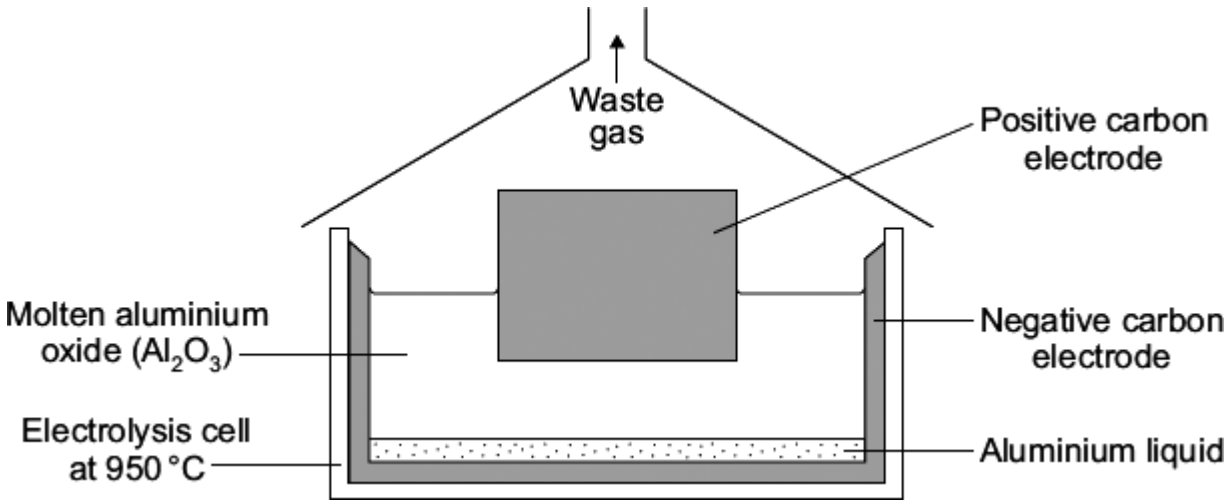
(1)

(b) Aluminium is used for drinks cans.
Aluminium is extracted from its purified ore by electrolysis.



(i) Suggest why the aluminium produced in the electrolysis cell is a liquid.

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(1)

(ii) In this electrolysis, aluminium and oxygen gas are produced from the aluminium oxide.

Use the information in the diagram to suggest why most of the waste gas is carbon dioxide and not oxygen.

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(2)

(iii) Aluminium is the most abundant metal in the Earth's crust.

Suggest **two** reasons why we should recycle aluminium drinks cans.

1 .....

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2 .....

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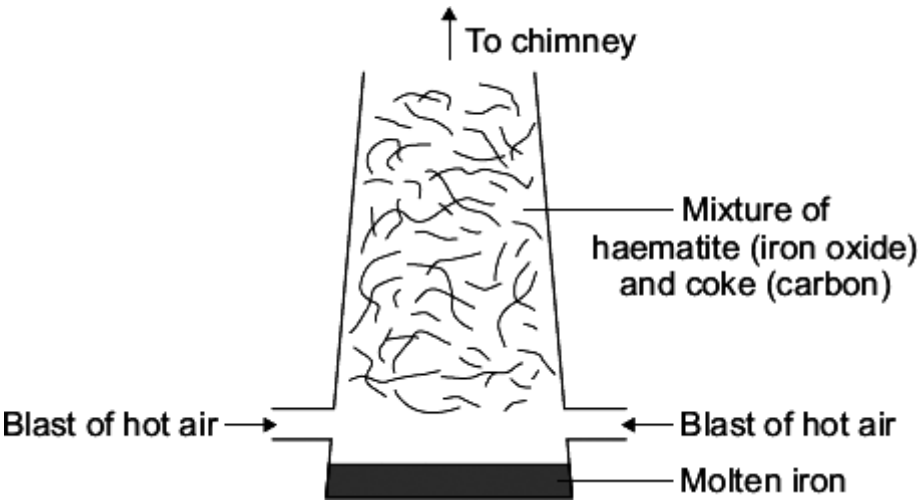
(2)
(Total 7 marks)

Q4. Iron is produced by reacting a mixture of haematite and coke in a blast furnace.
Haematite is an ore of iron containing iron oxide (Fe_2O_3).
Coke is made from coal and is almost pure carbon.



(a) (i) The coke burns in air. This reaction heats the furnace to above 1300 °C.

Complete the chemical equation for carbon reacting with oxygen to form carbon dioxide.

..... + O_2 → CO_2

(1)

(ii) Carbon monoxide is also formed in the furnace. Carbon monoxide reacts with iron oxide to produce iron and carbon dioxide.

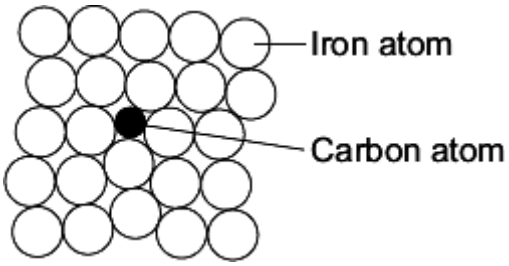
iron oxide + carbon monoxide → iron + carbon dioxide

Complete and balance the chemical equation for the production of iron.

Fe_2O_3 + 3CO → ..... + ...

(2)

(iii) Iron from a blast furnace is called cast iron and contains about 4% carbon.



Why is pure iron softer than cast iron?

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(1)

(b) Steel is made by reducing the percentage of carbon in cast iron and then adding different metals to form the type of steel required.

In the UK we use about 1.8 billion steel cans every year but only 30% of these are recycled. Recycling reduces waste. Producing steel from recycled cans requires only 25% of the energy needed to make steel from iron ore.

Give **three** environmental benefits of recycling a higher percentage of used steel cans.

1 .....

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2 .....

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3 .....

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(3)
(Total 7 marks)

Q5. Water sold in plastic bottles has a high 'carbon cost'.

The 'carbon cost' depends on the amount of carbon dioxide emitted in making and transporting the product.

The more carbon dioxide emitted, the higher the 'carbon cost'.

(a) Plastic water bottles are made from a polymer.
The polymer is made from ethene.
Ethene is made by cracking hydrocarbons.

(i) Name the polymer made from ethene.

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(1)

(ii) Ethene can be made by cracking the hydrocarbon pentane, C_5H_{12}.

$$C_5H_{12} \rightarrow C_2H_4 + C_3H_8$$

Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

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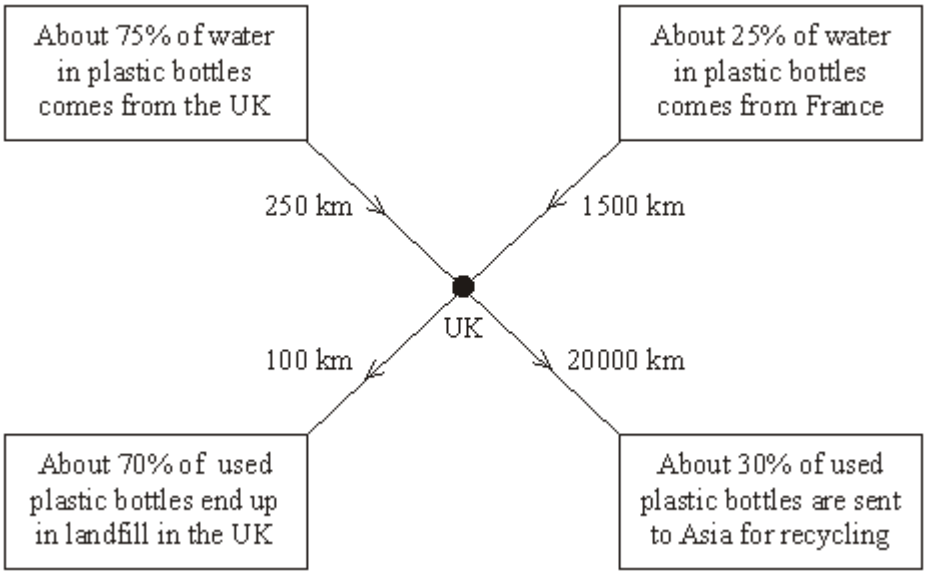
(2)

(b) The diagram shows information about water sold in plastic bottles in the UK.
The diagram also shows the average distances that water and plastic bottles are transported.



Suggest how the high 'carbon cost' of water sold in plastic bottles could be reduced.

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(3)

(Total 6 marks)

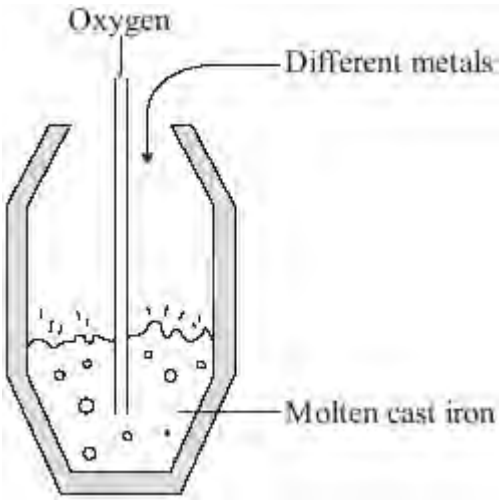
Q6. The demand for iron and steel is high.

(a) Iron that is extracted from its oxide by carbon reduction in a blast furnace is called cast iron. Cast iron contains about 4% carbon. This carbon makes cast iron very brittle.

Carbon steels can be made by the following processes.

- Blowing oxygen into molten cast iron to remove most of the carbon.
- Adding a calculated amount of carbon.

Sometimes different metals may also be added to the molten carbon steels.



(i) Suggest how blowing oxygen into molten cast iron removes most of the carbon.

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(2)

(ii) Why are different metals sometimes added to molten carbon steels?

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(1)

(b) The percentage of iron and steel recycled in the UK has been increasing.

Year	%iron and steel recycled
1998	25
2000	35
2002	42
2004	46
2006	57

The UK government has set targets for the percentage of iron and steel to be recycled. In 2006 the target was exceeded.

Suggest **two** reasons why the UK government wants to encourage recycling of iron and steel.

1 .....

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2 .....

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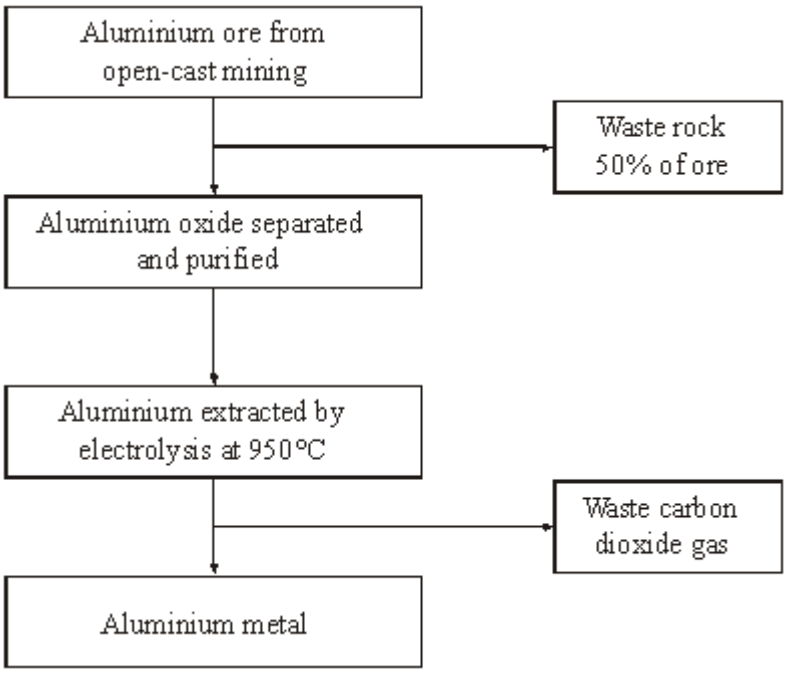
(2)
(Total 5 marks)

Q7. Aluminium has many uses because of its low density, good electrical conductivity, flexibility and resistance to corrosion.

The main steps in the extraction of aluminium are shown in the flow chart.



(a) Use the information in the flow chart to suggest the benefits of recycling aluminium.

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(3)

(b) Pure aluminium is rarely used for the construction of large objects. Small amounts of other metals are usually mixed with aluminium.

Explain why.

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(2)
(Total 5 marks)

Q8. Many everyday items are made from iron.

(a) Haematite is an *ore* of iron. Haematite contains iron oxide, Fe_2O_3.

(i) What is the meaning of the term *ore*?

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(1)

(ii) Iron can be produced by reacting iron oxide with carbon in a blast furnace.

What type of reaction produces the iron?

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(1)

(iii) The word equation for this reaction is:

iron oxide + carbon → iron + carbon dioxide

Complete and balance the symbol equation for this reaction.

.....Fe_2O_3 + ...C → ..... + ...

(2)

(b) Pure iron is relatively soft and not very strong.

The iron from the blast furnace is very hard and brittle. It contains about 4% carbon and is used as cast iron.

Pure iron Cast iron

Explain the differences in the properties of pure iron and cast iron by referring to the diagrams.

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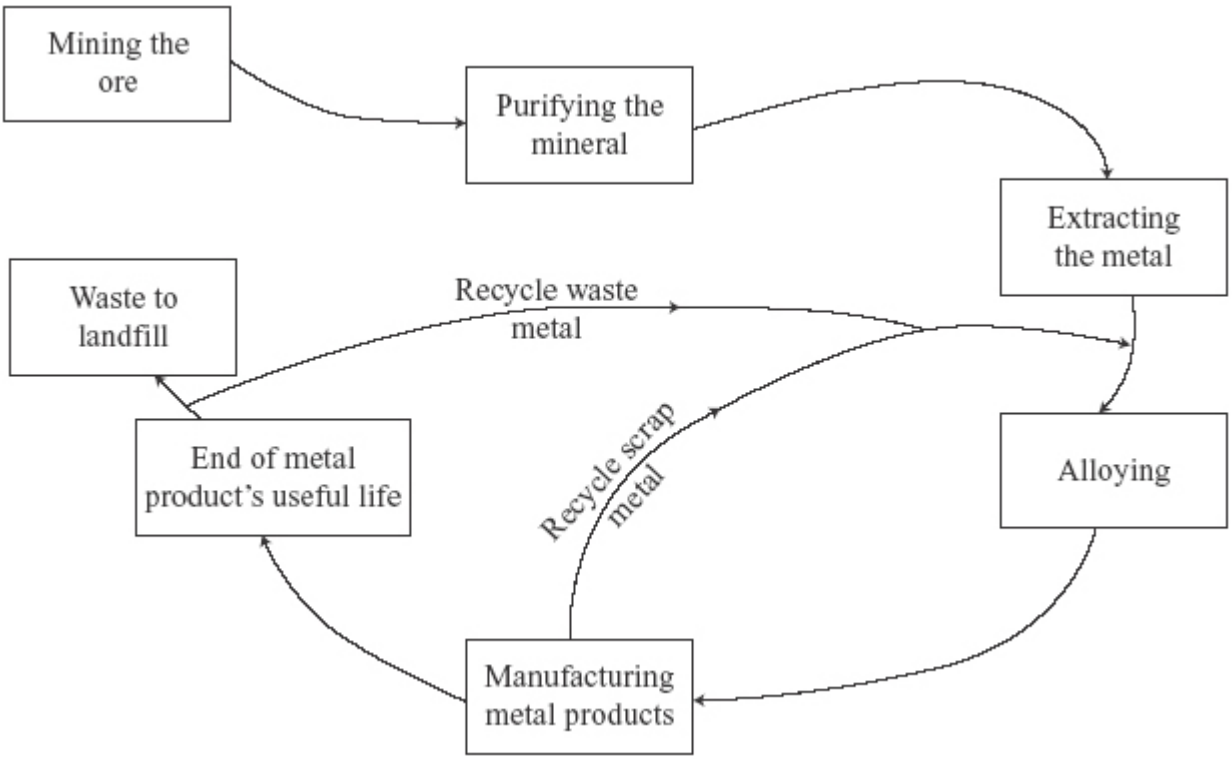
(3)

(c) The diagram shows the way in which iron is extracted, used and recycled.



Explain why the recycling of iron is necessary for sustainable development.

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(3)
(Total 10 marks)